

Draft Technical Memorandum

To: Columbia River CWR Project Team

From: John Palmer

Date: December 12, 2017

Subject: Volume of Cold Water Refuge Associated with the 26 Tributaries Providing CWR in the Lower Columbia River

This memo summarizes the sources of information to estimate the volume of cold water refuge (CWR) associated with the 26 tributaries that provide cold water refuge in the Lower Columbia River. Table 1 summarizes the attributes of each of the 26 tributaries including the volume of CWR that is greater than 2°C colder than the Columbia River and volume of CWR that is 18°C or less. The following is a listing of the EPA memorandums and reports to estimate the CWR volumes in Table 1.

- The selection of the 26 tributaries is described in *EPA Technical Memorandum: Screening Approach to Identify Tributaries That Currently Provide CWR in the Lower Columbia River, November 2, 2017*.
- The CWR volume estimates for the tributary plumes (except for Herman Creek, Wind River, and Little White Salmon River) is described in *Columbia River Coldwater Refuge Assessment Plume Modeling Report, Draft June 2017*.
- The CWR volume estimates for the “coves” (included in the Plume CWR volume in Table 1 and highlighted in green) for Herman Creek, Wind River and Little White Salmon River/Drano Lake are in the following EPA Memorandums: *Estimates of plume volumes associated with five tributary/confluence sites which USEPA collected data for this analysis during the summer of 2016, May 1, 2017*; *Estimated plume volume that is more than 2°C colder than the Columbia River at the Wind and Little White Salmon River confluence, May 22, 2017*; and *Calculation of water temperatures at the confluence of Herman Creek and the Columbia River, September 27, 2017*.
- The CWR volume estimates for the stream portion for each of the 26 tributaries is described in *EPA Memorandum: Estimating the Potential Coldwater refuge volume within tributaries that discharge into the Columbia River, October 24, 2017*. The stream length (SL) used in the above memorandum is based on *EPA Memorandum: Location of Upstream Extent of 26 CWR areas used by Migrating Salmon and Steelhead, November 2, 2017*.

Table 1

Estimated CWR Volumes for Tributaries Providing CWR in the Columbia River												
		River Mile	Mainstem Temp ¹	Tributary Temp ²	Temp Difference	Tributary Flow ³	Plume CWR Volume (> 2°C Δ) ⁴	Stream CWR Volume (> 2°C Δ) ⁵	Total CWR Volume (> 2°C Δ)	Plume CWR Volume (<18C)	Stream CWR Volume (<18C)	Total CWR Volume (<18C)
Code	Tributary Name		°C	°C	°C	cfs	m3	m3	m3	m3	m3	m3
28	Skamokawa Creek	30.9	21.3	16.2	-5.1	23	450	1,033	1,483	48	1,033	1,081
38	Mill Creek	51.3	21.3	14.5	-6.8	10	110	446	556	41	446	487
40	Abernethy Creek	51.7	21.3	15.7	-5.6	10	81	806	887	17	806	823
41	Germany Creek	53.6	21.3	15.4	-5.9	8	72	446	518	18	446	464
49	Cowlitz River	65.2	21.3	16.0	-5.4	3634	870,000	684,230	1,554,230	130,000	684,230	814,230
52	Kalama River	70.5	21.3	16.3	-5.0	314	14,000	57,089	71,089	980	57,089	58,069
63	Lewis River	84.4	21.3	16.6	-4.8	1291	120,000	493,455	613,455	13,000	493,455	506,455
77	Sandy River	117.1	21.3	18.8	-2.5	469	9,900	129,372	139,272	0	0	0
78	Washougal River ⁶	117.6	21.3	19.2	-2.1	107	740	32,563	33,303	0	0	0
83	Bridal Veil Creek	128.9	21.3	11.7	-9.6	7	120	0	120	54	0	54
85	Wahkeena Creek	131.7	21.3	13.6	-7.7	15	220	0	220	92	0	92
86	Oneonta Creek	134.3	21.3	13.1	-8.2	29	820	54	874	280	54	334
88	Woodward Creek	137.7	21.3	16.8	-4.4	11	64	0	64	8	0	8
89	McCord Creek	138.8	21.3	11.7	-9.6	15	380	0	380	190	0	190
90	Moffett Creek	139.8	21.3	12.8	-8.5	9	140	0	140	53	0	53
91	Tanner Creek	140.9	21.3	11.7	-9.6	38	1,300	413	1,713	630	413	1,043
	Bonneville Dam											
92	Eagle Creek	142.7	21.2	15.1	-6.1	72	2,100	888	2,988	610	888	1,498
94	Rock Creek ⁶	146.6	21.2	17.4	-3.8	47	530	1,178	1,708	26	1,178	1,204
96	Herman Creek	147.5	21.2	12.0	-9.2	45	168,000	1,698	169,698	93,958	1,698	95,656
100	Wind River	151.1	21.2	14.5	-6.7	293	60,800	44,420	105,220	20,390	44,420	64,810
112	Little White Salmon River	158.7	21.2	13.3	-7.9	88	1,097,000	4,126	1,101,126	531,524	4,126	535,650
115	White Salmon River	164.9	21.2	15.7	-5.5	715	72,000	81,529	153,529	14,000	81,529	95,529
116	Hood River	165.7	21.4	15.5	-5.9	374	28,000	0	28,000	7,500	0	7,500
125	Klickitat River	176.8	21.4	16.4	-5.0	851	73,000	149,029	222,029	3,300	149,029	152,329
	The Dalles Dam											
135	Deschutes River	200.8	21.4	19.2	-2.2	4772	300,000	580,124	880,124	0	0	0
	John Day Dam											
176	Umatilla River ⁶	284.7	20.9	20.8	-0.1	169	0	46,299	46,299	0	0	0
							Total Plume Volume	Total Stream Volume	Total CWR Volume	Plume V (<18C)	Stream V (<18C)	Total V (<18C)
						(M3)	2,819,827	2,309,198	5,129,025	816,719	1,520,840	2,337,559
						Olympic Pools	1,128	924	2,052	327	608	935
Notes												
¹ August Mean (10 year average) from nearest station in DART.												
² August Mean (NorWeST model estimate).												
³ August Mean (EROM model, except USGS gage for 6 tribs: Kalama, Lewis, Washougal, White Salmon, Klickitat, and Deschutes)												
⁴ Plume CWR Volume @ August Mean Trib Temp or measured temp for direct estimate method.												
Three methods used for Plume CWR Volume: CORMIX model, CORMIX regression, and direct method estimate based monitoring data.												
⁵ Stream CWR Volume based on estimated upstream range of CWR use and stream volume estimate method.												
⁶ Washougal, Rock and Umatilla only provide intermittent CWR: CWR volume represents volume when rivers are >2C colder than Columbia River.												